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There is a keen interest in using periodic structures to model such structures as phased arrays, frequency selective surfaces, and metamaterials. Recent interest has focused on modeling the truncation effects of periodic structures. The GIFFT (Green's function Interpolation using Fast Fourier Transform) method has recently been proposed as an efficient integral equation approach for handling moderate-to-large structures with essentially arbitrary (but identical) elements within each cell. The method uses an *array mask*— a listing of whether or not an element of the periodic structure is present at each potential cell location within the structure's bounding box—to simplify the handling of arbitrary array boundaries and missing elements.

The interaction between adjacent cells is treated using the method of moments in its usual form, but periodicity reduces the number of distinct near-interactions over the entire structure to a 3×3 block matrix. (The inverse of this block or even of its central block serves as an effective preconditioner.) The calculation of interactions between non-adjacent cells relies on the following features: 1) For cell sizes less than a few wavelengths, the Green's function is sufficiently smooth that it may be interpolated accurately over both source and observation points within interacting cell pairs via equi-spaced Lagrange polynomial interpolation. 2) Periodicity of the interpolation points over the entire transverse dimensions of the array implies that the Green's function samples connecting source and observation cell interpolating polynomials form a discrete convolution matrix. 3) Basis and testing function projections for subdomains within a cell are onto the cell interpolation polynomials, and the resulting projection matrix is identical for every cell of the structure. These features imply that the matrix/vector product in an iterative scheme can be accelerated using FFT to perform the discrete convolution between the Green's function sample matrix and the column vector of surface current projections onto interpolation polynomials. This GIFFT approach, which shares many features with the AIM method, is found to be ideal for quasi-planar periodic structures.

In this paper, we extend GIFFT to treat manufacturing defects in periodic structures that inevitably arise in producing nano-meter structures. Calculations for several structures of interest are presented. The main generalizations required are the following: 1) Both "background" and "defect" elements must now be separately defined in translatable unit cells. 2) The near-interaction block matrix must allow for the possibility of background-to-defect cell interactions. 3) Matrices of projections of both background and defect subdomain bases onto the interpolation polynomials must be defined and selected appropriately while forming the matrix/ vector product.

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